



TENTATIVE

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12.1" SVGA

TECHNICAL SPECIFICATION

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AA121SP06

MITSUBISHI ELECTRIC Corp.

Date: Feb.24,'09



CONTENTS

No.	Item	Page
--	COVER	1
--	CONTENTS	2
1	APPLICATION	3
2	OVERVIEW	4
3	ABSOLUTE MAXIMUM RATINGS	5
4	ELECTRICAL CHARACTERISTICS	5, 6, 7
5	INTERFACE PIN CONNECTION	8, 9
6	INTERFACE TIMING	10, 11, 12, 13, 14
7	BLOCK DIAGRAM	15
8	MECHANICAL SPECIFICATION	16, 17
9	OPTICAL CHARACTERISTICS	18, 19, 20
10	RELIABILITY TEST CONDITION	21
11	OTHER FEATURE	22
12	HANDLING PRECAUTIONS FOR TFT-LCD MODULE	23, 24, 25



1. APPLICATION

This specification applies to color TFT-LCD module, AA121SP06.

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(1) Standard Usage

Computers, office equipment, factory automation equipment, test and measurement equipment, communications, transportation equipment(automobiles, ships, trains, etc.), provided, however, that operation is not influenced by TFT-LCD directly.

(2) Special Usage

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(3) Specific Usage

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2. OVERVIEW

AA121SP06 is 12.1" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, and backlight unit.

By applying 6 bit or 8 bit digital data, 800×600 , 262k-color or 16.7M-color images are displayed on the 12.1" diagonal screen. Input power voltage is 3.3V for LCD driving.

The type of data and control signals are digital and transmitted via LVDS interface per Typ. 40MHz clock cycle.

Inverter for backlight is not included in this module. General specifications are summarized in the following table:

ITEM	SPECIFICATION
Display Area (mm)	246.0(H) $\times$ 184.5(V) (12.106-inch diagonal)
Number of Dots	800×3 (H) $\times$ 600 (V)
Pixel Pitch (mm)	0.3075 (H) $\times$ 0.3075 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white TN
Number of Color	262k(6 bit/color), 16.7M(8 bit/color)
Luminance (cd/m ²)	450
Wide Viewing Angle Technology	Optical Compensation Film
Viewing Angle (CR $\geq$ 10)	-80~80°(H) -60~80° (V)
Surface Treatment	Anti-glare and hard-coating 3H
Electrical Interface	LVDS (6 bit/8 bit)
Optimum Viewing Angle(Contrast ratio)	6 o'clock
Module Size (mm)	280.0 (W) $\times$ 210.0 (H) $\times$ 12.0 (D)
Module Mass (g)	770
Backlight Unit	CCFL, 2-tubes, edge-light, replaceable

Characteristic value without any note is typical value.

3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX	UNIT
Power Supply Voltage for LCD	VCC	0	4.0	V
Logic Input Voltage	VI	-0.3	VCC+0.3	V
Lamp Voltage	VL	0	2000	Vrms
Lamp Current	IL	0	18	mA _{rms}
Lamp Frequency	FL	--	100	kHz
Operation Temperature (Panel) Note 1,2)	T _{op(Panel)}	-30	80	°C
Operation Temperature (Ambient) Note 2)	T _{op(Ambient)}	-30	80	°C
Storage Temperature Note 2)	T _{stg}	-30	80	°C

[Note]

1) Measured at the center of active area and at the center of panel back surface

2) Top,Tstg ≤ 40°C : 90%RH max. without condensation

Top,Tstg > 40°C : Absolute humidity shall be less than the value of 90%RH at 40°C without condensation.

4. ELECTRICAL CHARACTERISTICS

(1) TFT-LCD

Ambient temperature: Ta = 25°C

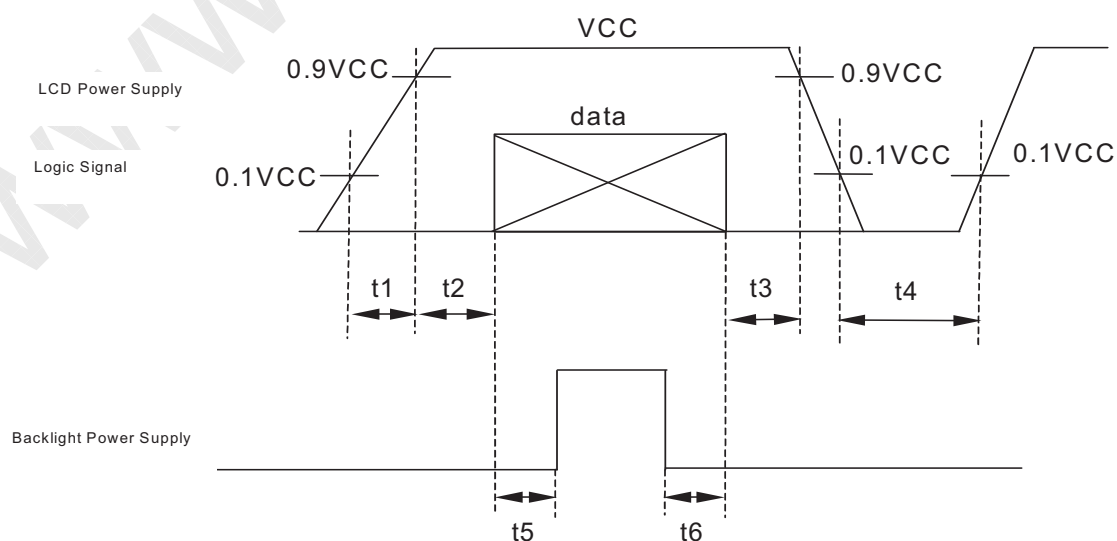
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Power Supply Voltages for LCD		VCC	3.0	3.3	3.6	V	*1)
Power Supply Currents for LCD		ICC	--	370	550	mA	*2)
Permissive Input Ripple Voltage		VRP	--	--	100	mVp-p	VCC = +3.3V
Logic Input Voltage	High	VIH	2.4	--	VCC	V	MODE, SC
	Low	VIL	0	--	0.8	V	MODE, SC

*1) Power and signals sequence:

$t_1 \leq 10 \text{ ms}$ $200 \text{ ms} \leq t_4$

$0 < t_2 \leq 50 \text{ ms}$ $200 \text{ ms} \leq t_5$

$0 < t_3 \leq 50 \text{ ms}$ $0 \leq t_6$

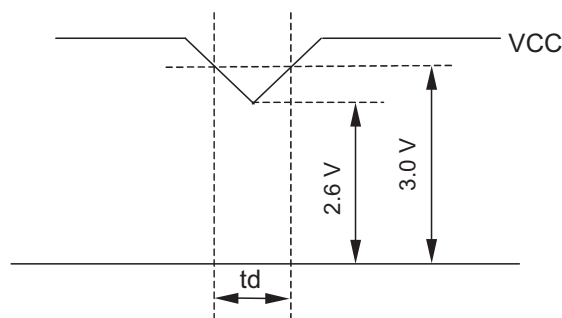


data: RGB DATA, DCLK, DENA, MODE, SC

VCC-dip conditions:

- 1) When $2.6\text{ V} \leq \text{VCC} < 3.0\text{ V}$, $t_d \leq 10\text{ ms}$
- 2) When $\text{VCC} < 2.6\text{ V}$

VCC-dip conditions should also follow the power and signals sequence.



*2) $\text{VCC} = +3.3\text{ V}$, $f_H = 37.9\text{ kHz}$, $f_V = 60\text{ Hz}$, $f_{\text{CLK}} = 40\text{ MHz}$

Display image of typical is 256-gray-bar pattern (8 bit), 600 line mode.

*3) Fuse

Parameter	Fuse Type Name	Supplier	Remark
VCC	FCC16162AB	Kamaya Electric Co., Ltd.	*)

*) The power supply capacity should be designed to be more than the fusing current.

(2) Backlight

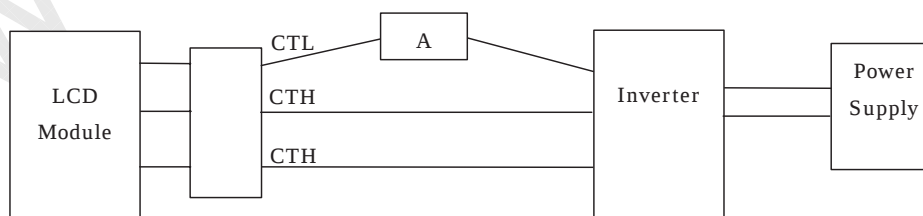
$T_a = 25^\circ\text{C}$

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Lamp Voltage	VL	--	540	--	Vrms	$I_L = 12.0\text{ mArms}$
Lamp Current	IL	6.0	12.0	14.0	mArms	*2), *6)
Lamp Frequency	FL	30	--	70	kHz	*3)
Starting Lamp Voltage	VS	1000	--	--	Vrms	$T_a = 25^\circ\text{C}$
		1200	--	--		$T_a = 0^\circ\text{C}$
		1320	--	--		$T_a = -30^\circ\text{C}$
Lamp Life Time	LT	50,000	--	--	h	*4), *5) $I_L = 12.0\text{ mArms}$, Continuous operation

[Note]

*1) Please use synchronous inverter.

*2) Lamp Current measurement method (The current meter is inserted in low voltage line.)



*3) Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.

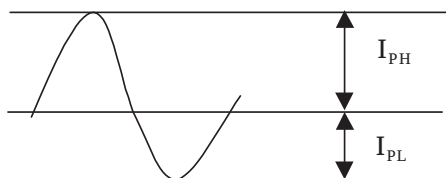
*4) Lamp life time is defined as the time either when the brightness becomes 50% of the initial value, or when the starting lamp voltage does not meet the value specified in this table.

*5) The life time of the backlight depends on the ambient temperature. The life time will decrease under low/high temperature.

*6) Please use the inverter which has symmetrical current wave form as follows,

The degree of unbalance: less than 10%

The ratio of wave height: less than $\sqrt{2} \pm 10\%$



I_{PH} : High side peak

I_{PL} : Low side peak

The degree of unbalance = $|I_{PH} - I_{PL}| / I_{rms} \times 100(\%)$

The ratio of wave height = $I_{PH}(\text{or } I_{PL}) / I_{rms}$

CURRENT WAVE FORM

5. INTERFACE PIN CONNECTION

(1) CN 1(Interface Signal)

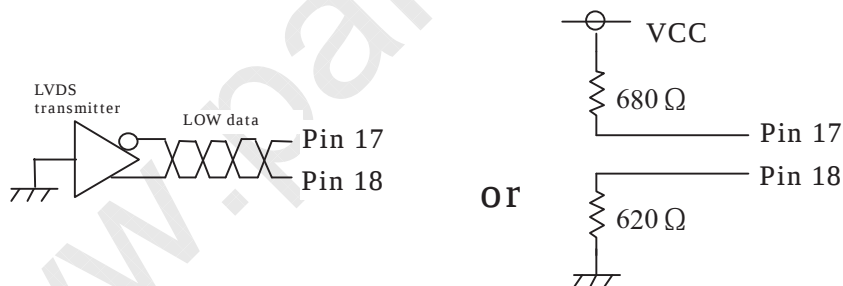
Used connector: FI-SEB20P-HFE (JAE)

Corresponding connector: FI-S20S[for discrete Wire] (JAE)

Pin No.	Symbol	Function(ISP 6 bit compatibility mode)		Function(ISP 8 bit compatibility mode)
		6 bit input	8 bit input	
1	VCC	+3.3 V Power supply		←
2	VCC	+3.3 V Power supply		←
3	GND	GND		←
4	GND	GND		←
5	Link 0-	R0, R1, R2, R3, R4, R5, G0	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
6	Link 0+	R0, R1, R2, R3, R4, R5, G0	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
7	GND	GND		←
8	Link 1-	G1, G2, G3, G4, G5, B0, B1	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
9	Link 1+	G1, G2, G3, G4, G5, B0, B1	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
10	GND	GND		←
11	Link 2-	B2, B3, B4, B5, DENA	B4, B5, B6, B7, DENA	B2, B3, B4, B5, DENA
12	Link 2+	B2, B3, B4, B5, DENA	B4, B5, B6, B7, DENA	B2, B3, B4, B5, DENA
13	GND	GND		←
14	CLKIN-	Clock -		←
15	CLKIN+	Clock +		←
16	GND	GND		←
17	Link3-	See: *2)	R0, R1, G0, G1, B0, B1	R6, R7, G6, G7, B6, B7
18	Link3+	See: *2)	R0, R1, G0, G1, B0, B1	R6, R7, G6, G7, B6, B7
19	MODE	Low=ISP 6 bit compatibility mode		High=ISP 8 bit compatibility mode
20	SC	Scan direction control. (Low : Normal , High : Reverse)		←

*1) Metal frame is connected to signal GND.

*2) Recommended wiring of Pin 17,18 (6 bit input)



(2) CN 2(Backlight)

Backlight-side connector: BHR-03(4-3)VS-1N (JST)

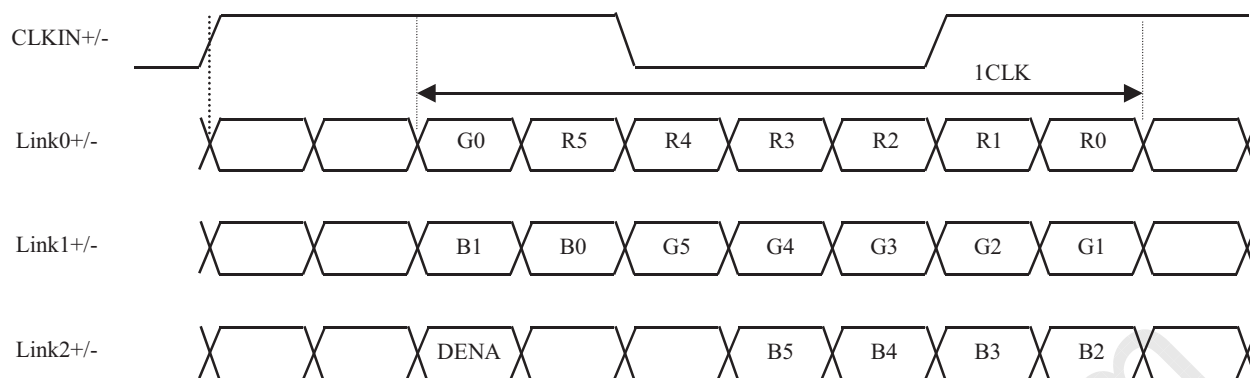
Inverter-side connector: SM04(4.0)B-BHS(LF)(SN) (JST)

Pin No.	Symbol	Function
1, 2	CTH	VBLH (High voltage)
3	CTL	VBL (Low voltage)

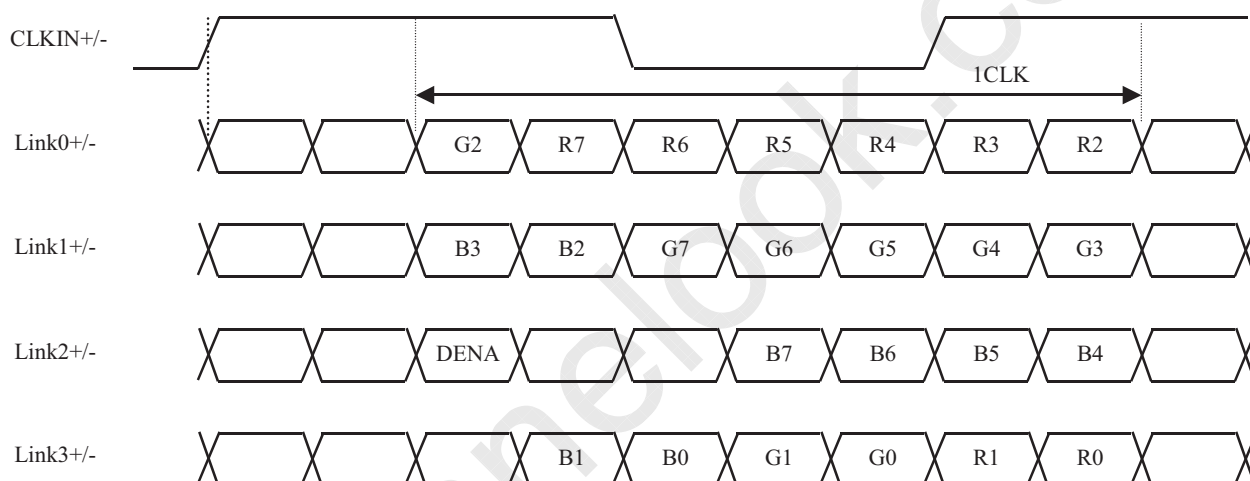
[Note] VBLH - VBL = VL

(3) ISP data mapping

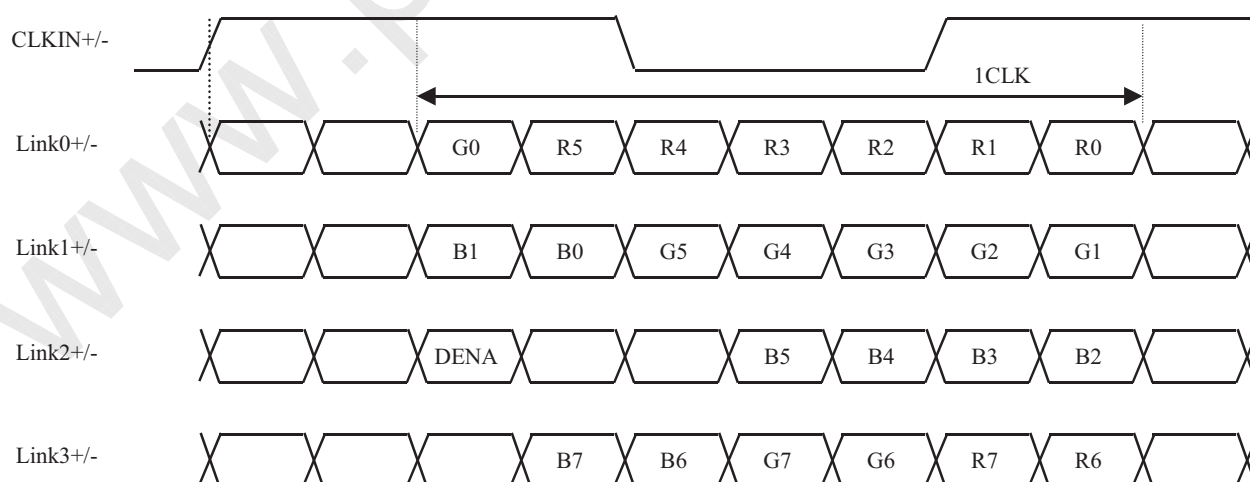
a. ISP 6 bit compatibility mode(6 bit input)



b. ISP 6 bit compatibility mode(8 bit input)



c. ISP 8 bit compatibility mode





6. INTERFACE TIMING

LVDS transmitter input signal

(1) Timing Specifications

ITEM			SYMBOL	MIN	TYP	MAX	UNIT
DCLK	Frequency		f _{CLK}	35	40	42	MHz
	Period		t _{CLK}	23.8	25	28.6	ns
DENA	Horizontal	Active Time	t _{HA}	800	800	800	t _{CLK}
		Blanking Time	t _{HB}	20	256	--	t _{CLK}
		Frequency	f _H	35.2	37.9	39.2	kHz
		Period	t _H	25.5	26.4	28.4	μs
	Vertical	Active Time	t _{VA}	600	600	600	t _H
		Blanking Time	t _{VB}	3	28	--	t _H
		Frequency	f _V	55	60	64.2	Hz
		Period	t _V	15.6	16.7	18.2	ms

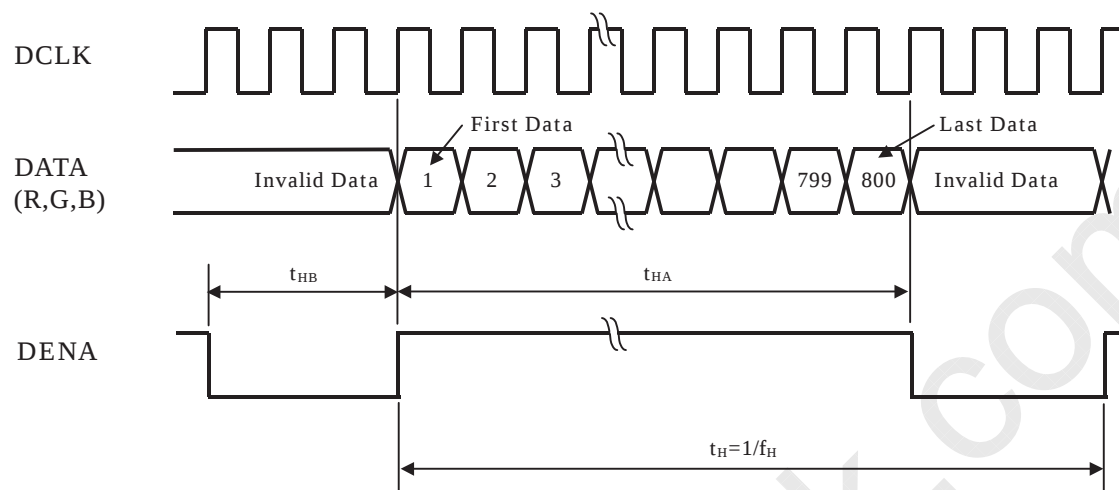
[Note]

- 1) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
- 2) DCLK should appear during all invalid period.
- 3) LVDS timing follows the timing specifications of LVDS receiver IC: THC63LVDF84B(Thine).
- 4) In case of blanking time fluctuation, please satisfy following condition.

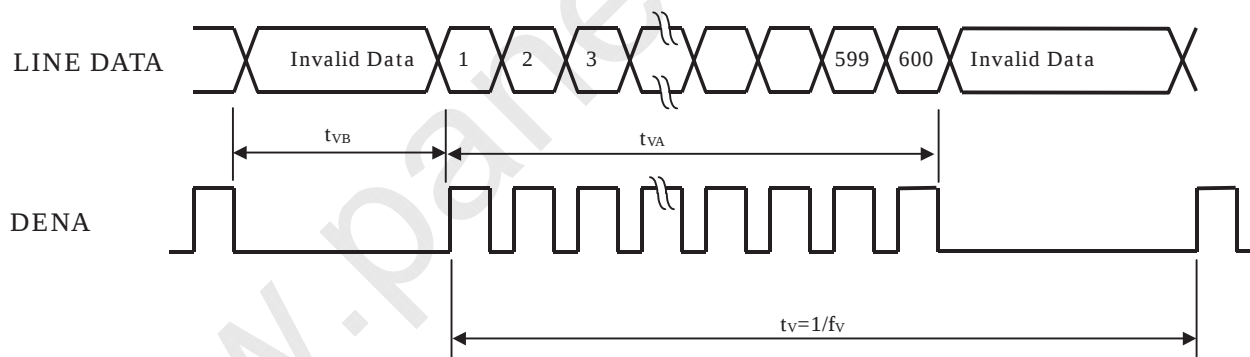
$$t_{VBn} > t_{VBn-1} - 3(t_H)$$

(2) Timing Chart

a. Horizontal Timing Chart



b. Vertical Timing Chart



(3) Color Data Assignment

a. 6 bit input

COLOR		INPUT DATA																	
		R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		MSB					LSB	MSB					LSB	MSB					LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GREEN(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

[Note]

1) Definition of gray scale

Color (n) --- n indicates gray scale level.

Higher n means brighter level.

2) Data

1:High, 0: Low

b. 8 bit input

COLOR		INPUT DATA																							
		R DATA								G DATA								B DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB				LSB				MSB				LSB				MSB				LSB			
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(1)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

[Note]

1) Definition of gray scale

Color (n) --- n indicates gray scale level.

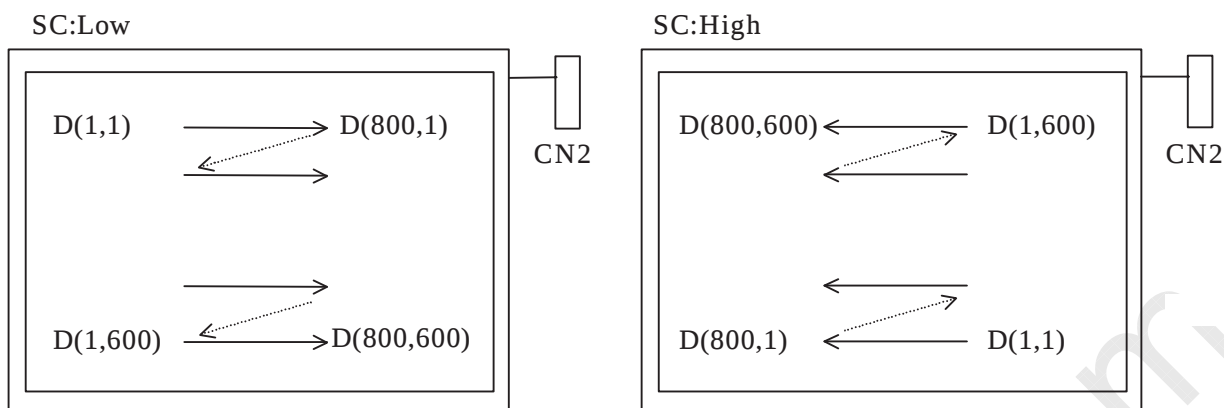
Higher n means brighter level.

2) Data

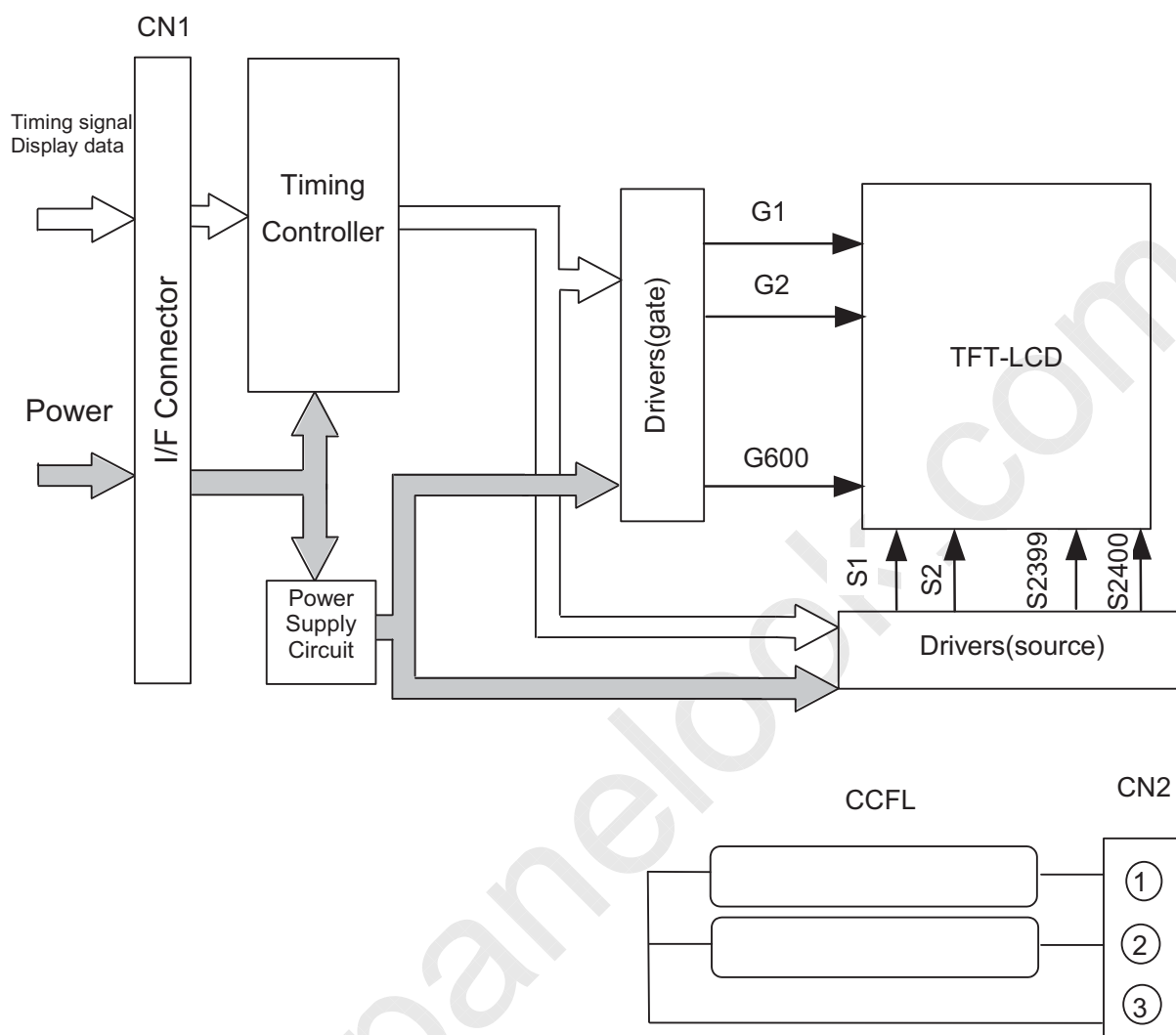
1:High, 0: Low

(4) Display Position and Scan Direction

D(X,Y) shows the data number of input signal for LCD panel signal processing PCB.

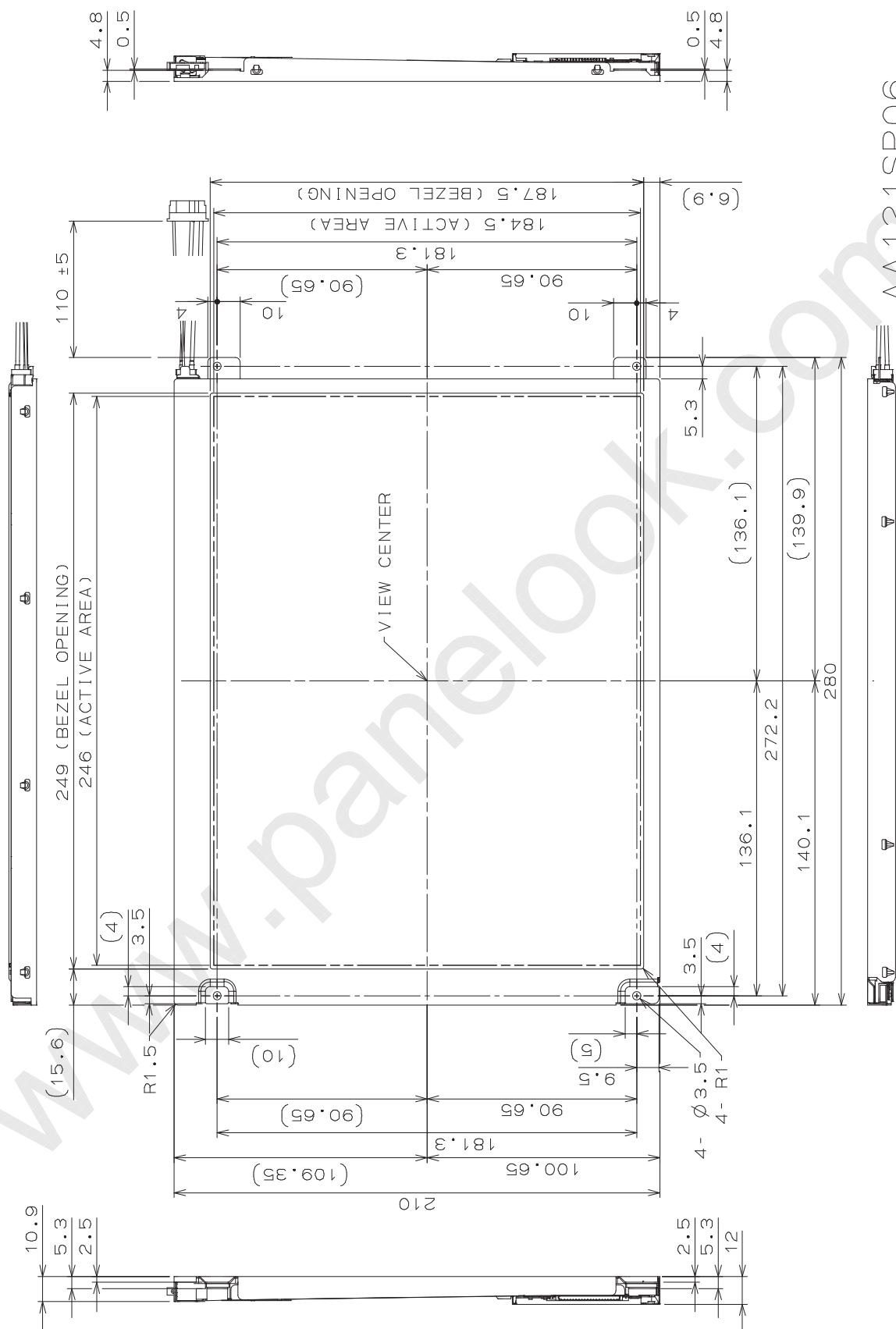


7. BLOCK DIAGRAM



8. MECHANICAL SPECIFICATIONS

(1) Front Side

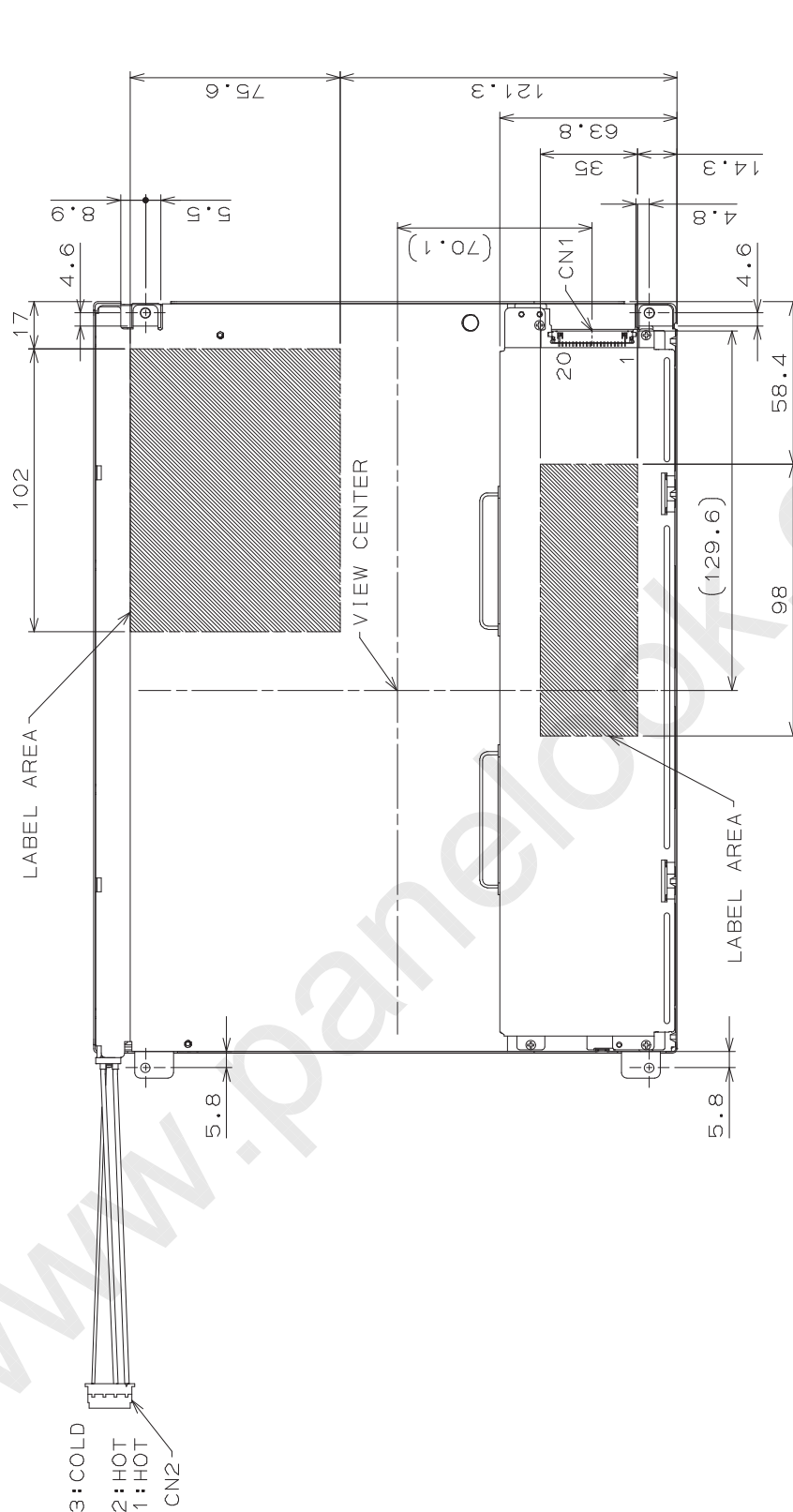


AA121SP06

- 1) Tolerance is ±0.5mm unless noted.
2) Third angle projection

(Unit: mm)

(2) Rear Side



AA121SP06

1) Tolerance is $\pm 0.5\text{mm}$ unless noted.
 2) Third angle projection

CN1: FI-SEB20P-HFE(JAE)
 CN2: BHR-03(4-3)VS-1N(JST)

(Unit:mm)

9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, Input Signals: Typ. Values shown in Section 6

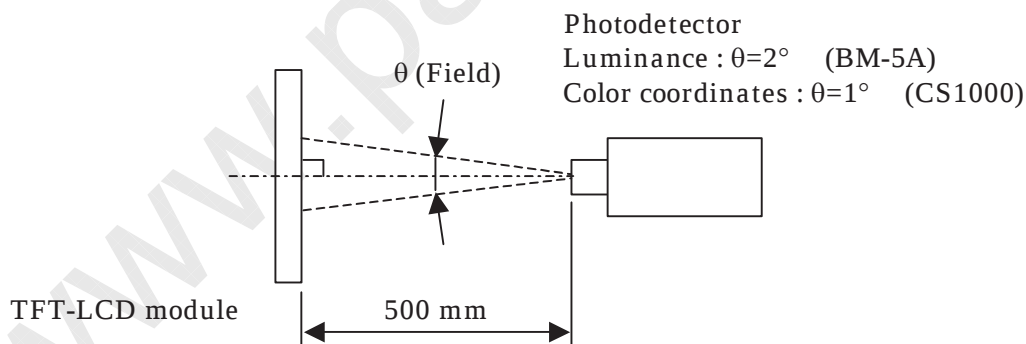
ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	Remarks
Contrast Ratio		CR	$\theta_V=0^\circ, \theta_H=0^\circ$	400	600	--	--	*1)*2)*5)
Luminance		L _w	$\theta_V=0^\circ, \theta_H=0^\circ$	360	450	--	cd/m ²	*1)*5)
Luminance Uniformity		ΔL_w	$\theta_V=0^\circ, \theta_H=0^\circ$	--	--	30	%	*1)*3)*5)
Response Time		t _r	$\theta_V=0^\circ, \theta_H=0^\circ$	--	4	--	ms	*1)*4)*5)
		t _f	$\theta_V=0^\circ, \theta_H=0^\circ$	--	12	--	ms	*1)*4)*5)
Viewing Angle	Horizontal	θ_H	CR ≥ 10	-65~65	-80~80	--	°	*1)*5)
	Vertical	θ_V		-45~65	-60~80	--	°	*1)*5)
Image sticking		t _{is}	2 h	--	--	--	2	*6)
Color Coordinates	Red	R _x	$\theta_V=0^\circ, \theta_H=0^\circ$	0.543	0.573	0.603	--	*1)*5)
		R _y		0.307	0.337	0.367		
	Green	G _x		0.288	0.318	0.348		
		G _y		0.506	0.536	0.566		
	Blue	B _x		0.130	0.160	0.190		
		B _y		0.125	0.155	0.185		
	White	W _x		0.283	0.313	0.343		
		W _y		0.299	0.329	0.359		

[Note]

These items are measured using CS1000(MINOLTA) for color coordinates, EZContrast(ELDIM) for viewing angle and CS1000 or BM-5A(TOPCON) for others under the dark room condition (no ambient light) after more than 30 minutes from turning on the lamp unless noted.

Condition: IL = 12.0 mArms, FL=43 kHz

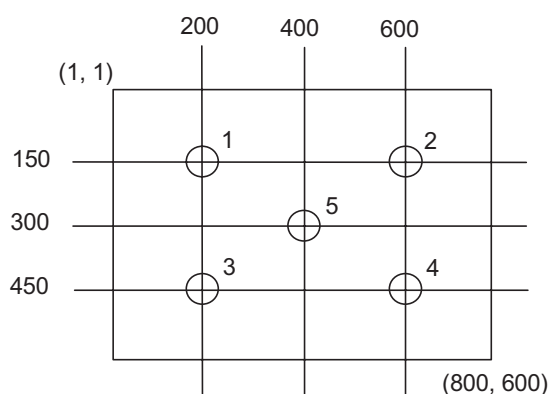
Measurement method for luminance and color coordinates is as follows.



The luminance is measured according to FLAT PANEL DISPLAY MEASUREMENTS STANDARD (VESA Standard).

*1) Measurement Point

Contrast Ratio, Luminance, Response Time, Viewing Angle, Color Coordinates: Display Center
Luminance Uniformity: point 1~5 shown in a figure below



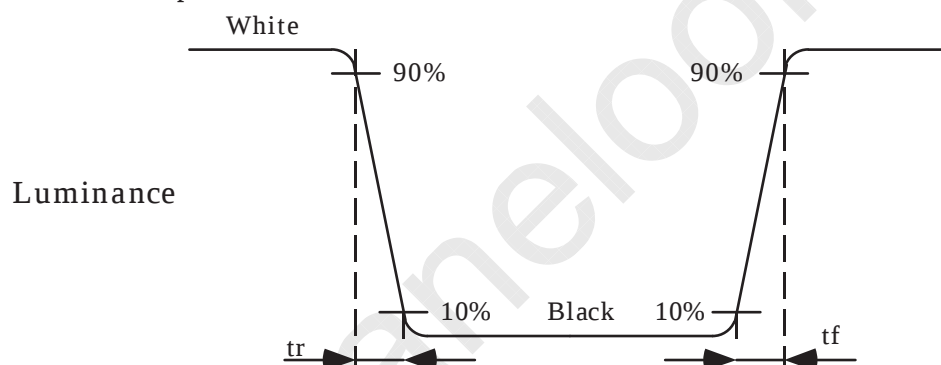
*2) Definition of Contrast Ratio

$CR = \text{Luminance with all white pixels} / \text{Luminance with all black pixels}$

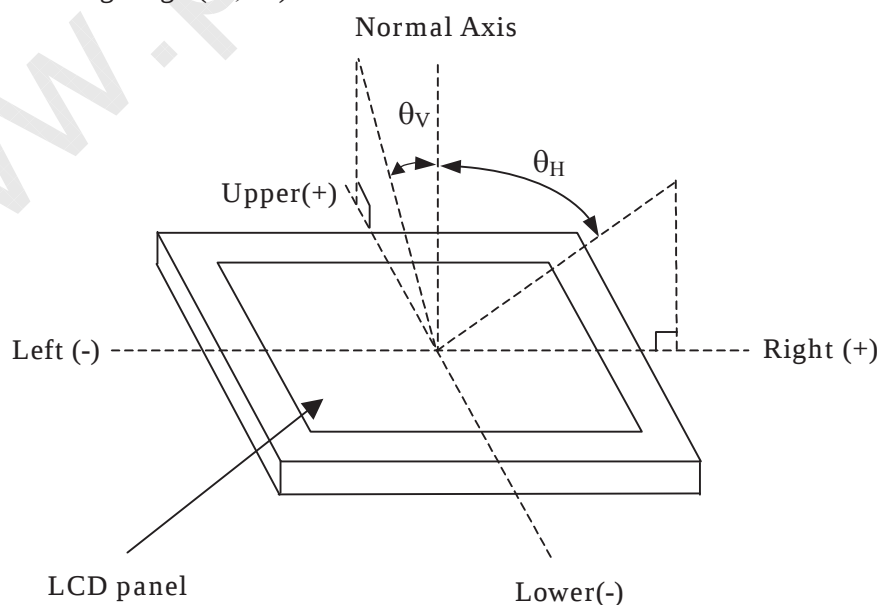
*3) Definition of Luminance Uniformity

$\Delta L_w = [L_w(\text{MAX}) / L_w(\text{MIN}) - 1] \times 100$

*4) Definition of Response Time

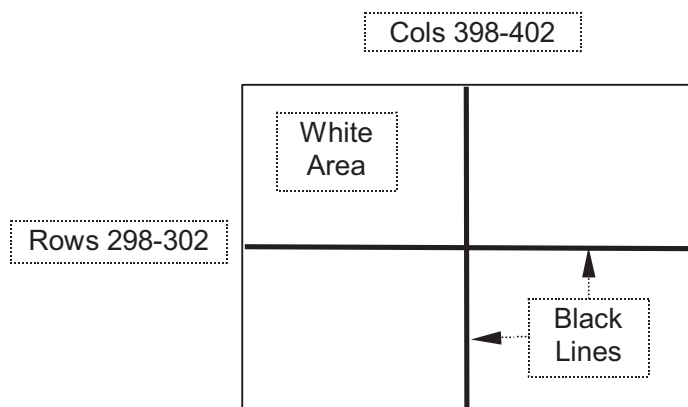


*5) Definition of Viewing Angle(θ_v , θ_H)



*6) Image sticking:

Continuously display the test pattern shown in the figure below for two-hours. Then display a completely white screen. The previous image shall not persist more than two seconds at 25°C.



TEST PATTERN FOR IMAGE STICKING TEST



11. OTHER FEATURE

This LCD module complies with RoHS Directive.

RoHS: Restriction of Hazardous Substances Directive
European Union



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o t e o t e a p.

(6) OTHERS

- a. A tro e t t to LCD pa e a a e eter orat o to po ar er , o or ter,
a ot er ater a , e ra e t e a t o pa ara ter t . P ea e o ot
e po e LCD o e er tro U tra o et ra ora o t e.
- b. P ea e pa atte to to a pa e e o LCD o e ot to o ta t t ot er ater a
pre er t a o e.
- . For t e pa a bo a , p ea e ee a obe t t e pa a pe at o
ata eet.